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On Presumed Hybrid Origin of the Genus *Sasaella* Makino (Bambusaceae)

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アズマザサ属の雑種起源の研究

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A hypothesis of hybrid origin of *Sasaella* was tested by morphological comparison. Based on the flower morphology, *Sasaella ramosa* and *S. masamuneana* were shown to have been derived through hybridization between *Pleioblastus chino* and *Sasa nipponica* or *S. palmata.*

The genus *Sasaella* was established by Makino (1929), who picked up some species belonging to *Bambusa, Sasa* and *Arundinaria. Sasaella* is characterized by some distinct features such as fimbriate shoulder bristiles and one branch or branchlet per node. However, Nakai (1934) included *Sasaella* into *Arundinaria* while Ohwi (1953) treated *Sasaella* as a member of the genus *Sasa.* Maekawa (1960) considered that *Sasaella* might been derived through hybridization between *Sasa* and *Pleioblastus* because of the intermediate appearance of the shoulder bristles on the leaf-sheath of *Sasaella.* Suzuki (1987) supported Maekawa's opinion in his review of Japanese Bambusaceae. Murata (1977) disagreed with Maekawa's opinion and adopted Nakai's systematic treatment.

In this paper we observe the floral morphology and the fertility of pollen and seeds of *Sasaella* and related genera in order to exemplify Maekawa's idea on the origin of *Sasaella.*

Materials and Methods

Localities, date of sampling and areas of flowering population of the materials were observed (Table 1). More than fifty inflorescences, which were randomly collected from each population, have been examined. The morphology of inflorescences, spikelets and florets, the number of stamens in a floret, the length of anthers and the size and fertility of pollen have been compared. The length of the first and the second glumes and that of anthers were measured with slide calipers. Pollen fertility was estimated by the aceto-orcein staining method and seed fertility of *Sasaella ramosa* was investigated by sowing 53 fresh seeds on wet blotting papers. No seed was obtained from *Sasaella masamuneana.*

Table 1. Materials used for the analysis of floral characters.

Material	Date of sampling	Locality	Size of flowering population
Sasaella			
S. ramosa Makino	MAY. '85, '86	Okorogawa, Tochigi Pref.	20×40m
S. ramosa Makino	MAY. '85, '86, '87, '88	Kurohone, Gunma Pref.	3×20m, 10×15m
S. masamuneana Hatusima et Muroi	APR. '87, '88	Kanazawa Univ. Ishikawa Pref.	5×20m
Sasa			
S.nipponica Makino	MAY. '85, '87, '88	Oku-Nikko, Tochigi Pref.	50×50m
S.palmata Nakai	MAY. '85, '87, '88	Oku-Nikko, Tochigi Pref.	5×30m
Pleioblastus			
P.chino Makino	APR. '85, '87, '88	Utunomiya Univ. Forest in Funyu, Tochigi Pref.	10×50m

Examination and Discussion

1) Morphology of inflorescence

The morphology of inflorescences of 3 genera of the "Sasa group" is diagrammatically shown (Fig. 1). *Pleioblastus chino* has only a terminal single spikelet or a terminal verticillaster, *Sasa nipponica* has an axillary panicle. *Sasaella ramosa* and *S. masamuneana* have both a terminal single spikelet and an axillary panicle. That is to say, *Sasaella* exhibits an intermediate type of in-

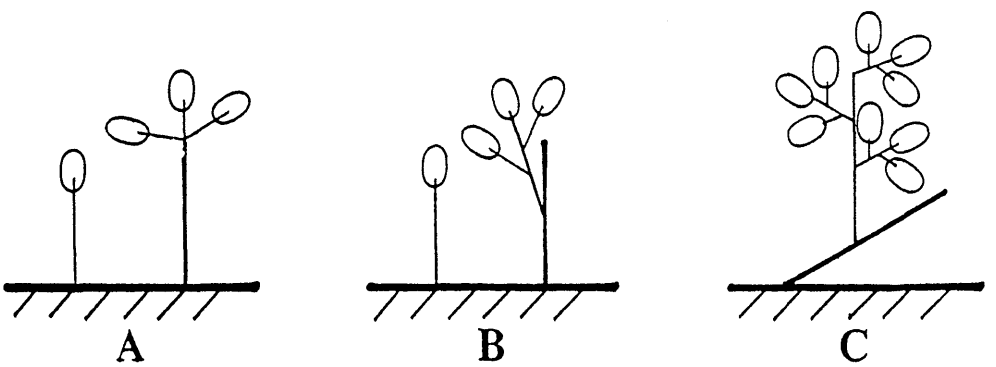

Fig. 1. Diagrammatic representations of inflorescences of *Sasa* group; each ellipsoid shows a spikelet.
A: *Pleioblastus chino*; the spike or verticillaster type.
B: *Sasaella ramosa* and *Sasaella masamuneana*; the intermediate types of A and C.
C: *Sasa nipponica* and *Sasa palmata*; the panicle type.

floresence between *Sasa nipponica* and *S. palmata* and *Pleioblastus chino*.

2) Pollination mechanism

Fundamentally, the mode of pollination in "Sasa group" is so-called neighboring pollination, a kind of self-pollination. The stamens protrude from a floret, then hang their anthers and dehiscing, and pollen in such a way that the stigma accepts pollen from the upper florets. When the wind blows the stigma may have the chance to receive pollen from other plants for hybridization.

3) Morphology of the spikelet and the floret

The size of the first and the second glume, the ratio between the lengths of glume and lemma, and that between the lengths of anther and lemma in Gramineae are importantly effective as diagnostic characters (Tateoka, 1959, 1975).

Length-ratios between the first glume and lemma in five species are drawn (Fig. 2). As far as examined, *Sasa* has very short first glume and short lemma which are less than 3mm long and 6–11mm long respectively. They are plotted as a concentrated group in the lower-left corner in Fig. 2. In contrast, *Pleioblastus* has longer first glume 10–16mm long and lemma 13–18mm long. They are plotted in the upper-right corner of Fig. 2. While, *Sasaella* has intermediate size, first glume and lemma are 4–9mm and 9–17mm long, respectively.

We tried to compare the length of the first glumes with that of the second. However, we could not obtain any definite result distinguishing two taxa of *Sasaella* as different species.

4) Morphology of stamens

The number of stamens in florets is exclusively 3 in *Pleioblastus,* and 6 in *Sasa*. No variation in

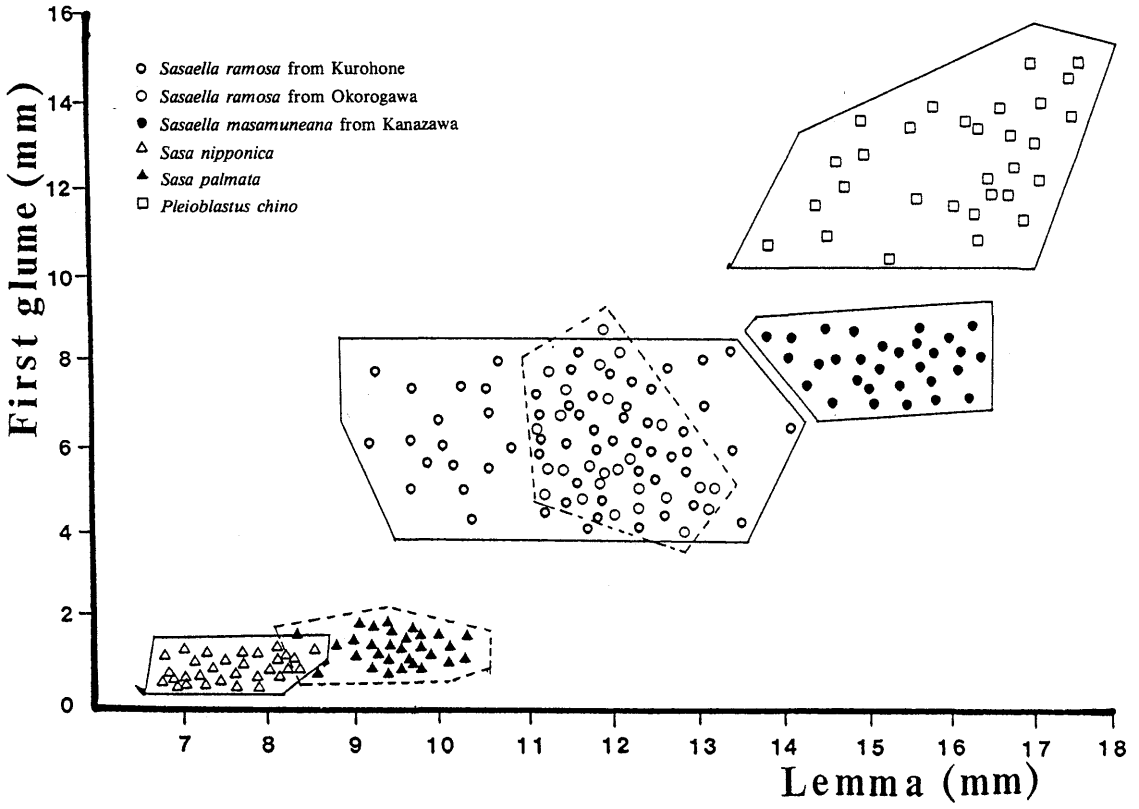

Fig. 2. Correlation between first glume length and lemma length.

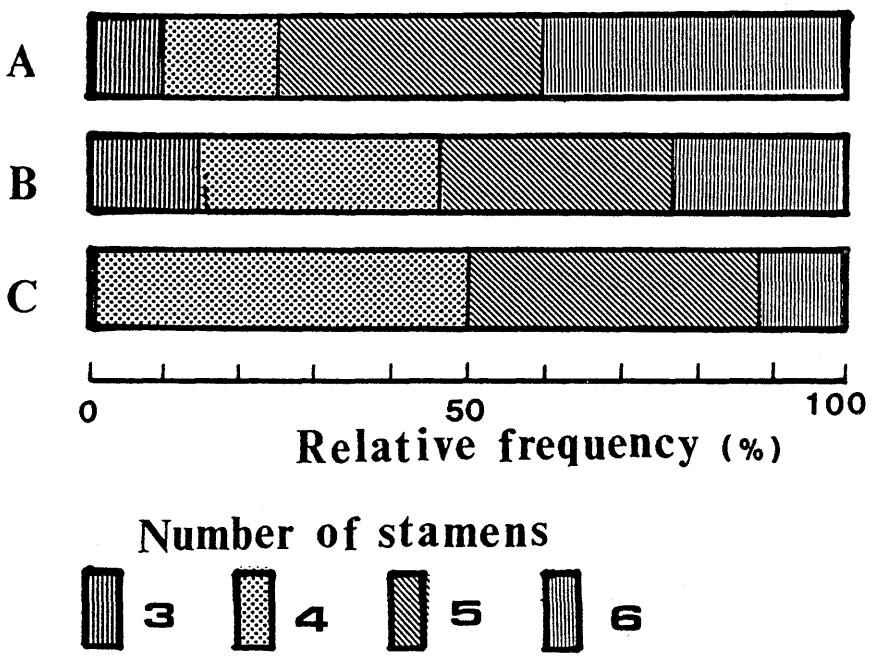

Fig. 3. Frequency distribution of the stamen number of *Sasaella ramosa* and *S. masamuneana*.
A: *S. ramosa* from Kurohone; B: *S. ramosa* from Okorogawa; C: *S. masamuneana* from Kanazawa.
The numbers of counted florets in A, B, and C are 385, 180 and 250, respectively.

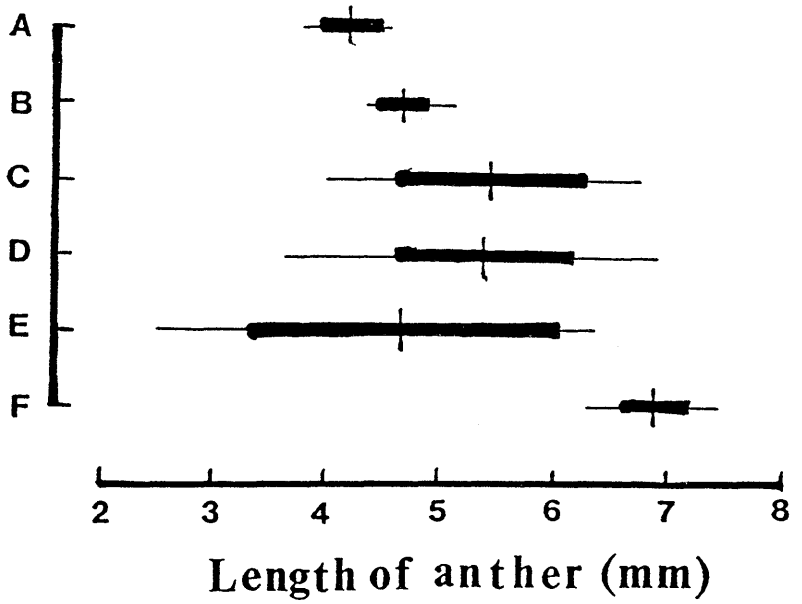

Fig. 4. Variation in anther length (maximum, minimum, mean and S.D.) of "*Sasa* group" examined.
A: *Sasa nipponica*; B: *S. palmata*; C: *Sasaella ramosa* from Kurohone; D: *S. ramosa* from Okorogawa; E: *S. masamuneana* from Kanazawa; F: *Pleioblastus chino*.

number was examined in either genera. On the other hand, the florets of *Sasaella ramosa* and *S. masamuneana* have 3 to 6 stamens (Fig. 3).

The length of anthers in 5 species is shown by a variation diagram (Fig. 4). *Sasa* sepcies have distinctly shorter anthers than those of *Pleioblastus chino* and the range of sample mean of these species is fairly narrow. The range is 3.80mm to 4.75mm in *S. nipponica,* 4.12mm to 5.26mm in *S. palmata,* and 6.69mm to 7.42mm in *P. chino.* On the other hand, the length in *Sasaella* is very variable, and their range, were 3.68mm to 6.95mm in *S. ramosa* and 2.45mm to 6.13mm in *S. masamuneana.* The degree of variation in *Sasaella* was summarized by histograms and its range of sample mean with interval estimation was calculated within a 95% confidence limit using Student's T distribution.

5) Fertility of pollen and seed

Pollen fertility of the 5 species of the "*Sasa* group" have been estimated by aceto-orcein stainability. The results are shown in Table 2. The greater part of the pollen of *Sasa* and *Pleioblastus* is fertile. In contrast, about the half of the pollen produced by *Sasaella ramosa* is fertile, and the fertile pollen are very rare in *S. masamuneana.*

Pollen fertility was also judged by measuring pollen size. *Sasa nipponica* and *S. palmata* and *P. chino* produce exclusively uniform pollen. However the pollen size in *Sasaella ramosa* and *S. masamuneana* is irregular. The largest pollen grain is 35μm in diameter and the smallest one 16μm. This phenomenon suggests that their pollen are produced by irregular meiosis.

Though it is difficult to collect the seeds of the species of *Sasaella*, we procured the seeds of *S. ramosa* from one inflorescence. However, none of them germinated within 3 months or more after having been sown in incubation while seeds of *Sasa nipponica* and *S. palmata* and *Pleioblastus chino* germinated well within a week under the same conditions. Judging from the results, we would like to support the claim that the species *Sasaella* originated in an intergeneric hybrid between a species of *Sasa* and *Pleioblastus,* as initially suggested by Maekawa (1960).

Table 2. Pollen stainability.

Species	Mean	S.D.
Sasaella ramosa	52.34%	±15.91
Sasaella masamuneana	2.56%	± 2.11
Sasa nipponica	97.60%	± 0.92
Sasa palmata	95.76%	± 2.95
Pleioblastus chino	91.09%	± 6.32

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References

Koidzumi G. 1940. Stamens in *Arundinaria.* Acta Phytotax. Geobot. **9**:249 (in Japanese).

Maekawa F. 1960. Evolution is aspects of the inter-generic or inter-specific hybrid. Essays in celebration of the centennial anniversary of Darwinism. pp.115–124 (in Japanese).

Makino T. 1929. A contribution to the knowledge of the Flora of Japan. J. Jpn. Bot. **6**: 9–16.

McClure F. A. 1957. Typification of the genera of the Bambusoideae. Taxon. **6**:199–210.

Murata G. 1977. Taxonomical notes 13. Acta Phytotax. Geobot. **30**:134–139 (in Japanese).

Nakai T. 1934. Novitates *Bambusacearum* in

Imoperio Japonico recentissime detectae (I). J. Jpn. Bot. **10**:547–581.

Ohwi J. 1953. Flora of Japan. Shibundo. Tokyo (in Japanese).

Suzuki S. 1978. Index to Japanese Bambusaceae. GAKKEN, Tokyo (in Japanese).

———1987. New or noteworthy plants of Japanese Bambusaceae (5). J. Jpn. Bot. **8**:274–279.

Takagi T. 1963. On the Spikelets of *Sasa, Pleioblastus* and *Sasaella*. The reports of the Fuji Bamboo garden. **8**:58–68 (in Japanese).

Tateoka T. 1959. Explanation of Gramineae plants. Meibundo. Tokyo (in Japanese).

———1975. A contribution to the taxonomy of the *Agrostis* mertensii-flaccida complex (Poaceae) in Japan. Bot. Mag. Tokyo **88**:65–87.

———1983. Plant Speciation and Taxonomy. Yokendo. Tokyo (in Japanese).

Usui H. 1961. Phytosociological revision of the dominant species of *Sasa*-type undergrowth. Special Bulletin of the College of Agriculture Utsunomiya University. 11 (in Japanese)

要 旨

アズマザサ属（*Sasaella*）は牧野（1929）によって設立されたが，一方では，*Arundinaria*あるいはササ属（*Sasa*）に包含されることもありその分類学的帰属は必ずしも確定してない．その起源については，前川（1960）によって雑種説がのべられ，最近では鈴木（1987）もその説を支持しているが，アズマザサ属植物の雑種性に関する本格的な検討はされないまま今日に至った．本研究は，アズマザサ属植物の花に関する形態学的解析を行なうことによってその雑種性を明らかにしようと試みた．その結果，アズマザサ*Sasaella ramosa* Makinoとクリオザサ*Sasaella masamuneana* Hatusima et Muroiは，花形態の特徴（花序，小穂・小花の形態）から，ミヤコザサ*Sasa nipponica* Makinoまたはチマキザサ*Sasa palmata* Nakaiとアズマネザサ*Pleioblastus chino* Makinoの雑種であると推定された．